The Genesis Mission Sample Return

Studying the raw material of the Sun

This September 8, NASA is set to bring back a tiny sampling of the raw material of the Sun, a sample weighing no more than a few grains of salt.

The solar particles are sealed inside the Genesis sample return capsule, a disk about the size of a truck tire, that will drift toward Earth's surface beneath a parachute.

In labs specially designed to measure small numbers of atoms, scientists will begin years of close examination of the particles in search of new information about how the Sun and its family of planets came into being.

The sample is composed of the invisible ions (atoms stripped of many of their electrons) that flow off the Sun -- making up what's called the "solar wind." The solar wind streams constantly throughout our solar system. Like water flowing around a stone in a river, the solar wind moves along the outside of the magnetic fields of Earth and other planets. Sometimes, we can see an effect produced by the solar wind in the form of aurora near the Earth's poles. The glowing curtains of light are the colorful result of these particles spiraling into Earth's atmosphere along the magnetic field lines that dip inward at the poles.

Scientists have long wanted to capture a sample of particles straight from the Sun. While the Sun is mostly made up of hydrogen and helium, there are small amounts of all other elements as well. The exact composition of the Sun is yet to be determined, as is an understanding of how that chemical makeup resulted in the diverse collection of planets and other bodies in the solar system.

For the Genesis scientists, it is crucial that the particles be pure and unaltered from any interaction with Earth's magnetic field. To obtain this pristine sample, a spacecraft had to be sent deep into space, far beyond the extensive magnetic environment of Earth.

NASA's Genesis, a robotic spacecraft, was launched in August 2001 from Cape Canaveral, Florida. It traveled to an area in space between Earth and the Sun where the gravity of the two bodies is balanced. There, it collected solar wind particles for more than two years from an area in space far from the interfering effects of any planet.

The particles were embedded in specially designed and manufactured, high-purity wafers of sapphire, silicon, diamond and other materials. Now this pure sample of solar particles is being brought to Earth.

Source: NASA/JPL/Caltech

A few hundred feet above the vast, unoccupied grounds of the Utah Test and Training Range, the parachuting sample will be captured by a helicopter and gently delivered to the ground.

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Frequently Asked Questions (FAQ)

Is the sample safe to bring to Earth? -- The Genesis sample, consisting of protons, ions and atoms from the Sun, does not pose any risk to the Earth. The National Research Council's Space Studies Board determined that the sample has no potential for containing life or other material of concern. The samples are handled in clean rooms to protect them from contamination by Earth material -- not the other way around. They will be housed for study at the Advanced Curation Laboratory at NASA's Johnson Space Center in Houston.

What if it doesn't land on target? -- The return of the sample capsule is planned to occur at the Utah Test and Training Range (UTTR), a vast and unoccupied salt flat controlled by the U.S. Army and Air Force. The site was chosen because it provides an ample area to allow for aerodynamic uncertainties and winds that might affect the direction the capsule travels in the atmosphere. The area of the landing zone and its surrounding safety margin measures thousands of square miles. Based upon the nearly flawless performance of the spacecraft so far, combined with a history throughout the flight of being able to navigate the spacecraft extremely accurately, it is fully expected that the Genesis team will be able to deliver the capsule well inside this zone.

How does the sample come back to Earth? -- The sample return capsule, still attached to the main Genesis spacecraft, will be aligned to its proper entry orientation about six hours before entry. At that time it will be spun to 15 revolutions per minute, adding stability for its descent into Earth's atmosphere. The capsule will be released two hours later. After the capsule is released, the main spacecraft will be diverted so it cannot collide with the sample return capsule. Having completed its mission of carrying the return capsule and its scientific cargo, the spacecraft will fire its large thrusters one last time in a "divert maneuver" that will deliver it into an orbit around the Sun, just ahead of the Earth.

What if something goes wrong before the capsule is released? -- In the unlikely event of a problem preventing accurate targeting for entry, an option exists to delay the release of the capsule and make a course change that would place the entire spacecraft into orbit around the Earth. Another sample return attempt would follow approximately six months later.

How do you catch the sample before it hits the ground? -- Nearly 19 miles above the ground over UTTR, the capsule begins to decelerate by releasing a small "drogue" parachute, which helps to slow down and stabilize the 500-pound capsule. Moments later, when the capsule is about 20,000 feet above ground, a larger rectangular-shaped parafoil like a skydiver's chute allows the capsule to gently spiral downward at just 10 miles per hour. Meanwhile, two chase helicopters (one lead and one backup) outfitted with specially designed retrieval equipment, maneuver for a mid-air capture. The lead helicopter follows the parafoil's glide path, hooks and collapses the chute, and gently lowers the capsule into a sealed container. This is all done in an effort to safely transport the capsule to contamination-controlled laboratory tents, without disturbing the solar samples inside.

What if you miss catching it and it parachutes to the ground? If the sample return capsule lands on its own, some of the delicate collector materials will likely break, making the sample more difficult to identify and categorize. The sample would still be valuable, but it would take longer for scientists to sort through the broken pieces.

Are there any dangerous substances that could be released from the capsule? -- Batteries in the capsule contain sulfur dioxide, which, as with any battery, will be treated with caution in the capsule recovery.

What if it lands and you can't find it? -- Spacecraft tracking data would be used to determine the vicinity of the capsule, and a radio beacon would help pinpoint its location for pickup.

Will it make any strange noises or be visible as it comes in from space? – Probably not, but it's possible a sonic boom may be heard somewhere along the descent path from Oregon to Utah. The capsule probably will not make any visible streaks in the sky as it descends through the atmosphere but it might. The capsule itself is less than five feet in diameter, probably too small to be seen, though its parachute will be visible to the retrieval helicopter pilots and possibly to nearby viewers at the test range.

For more information, see http://www.genesismission.jpl.nasa.gov , or contact Aimee Whalen at 818-354-3245 or aimee.l.whalen@jpl.nasa.gov